ATTEN

AT7016 SINGLE TRACE
10MHz OSCILLOSCOPE

USER'S MANUAL

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1. SAFETY PRECAUTION

The AT7016 oscilloscope is easy to operate and highly reliable. It is an ideal instrument for research, production, education, and development. It is a compact and portable oscilloscope with a frequency bandwidth of 10MHz and sensitivity of 5mV/DIV-5V/DIV. Supplied as standard, with a switchable X10: X1 probe which extends the sensitivity up to 50V/div. The horizontal timebase is 0.1S/DIV to 0.1μS/DIV.

The instrument is designed and tested in accordance with EN publication 61010, CAT II, Pollution degree II and Overvoltage 600V. The instrument has been tested in accordance to the following EC Directives (EMC) :

a. EN50082

b. EN55011

c. EN610000-3-2

d. EN61000-3-3

The instrument complies with the requirements of the European Council Directive 89/336/EEC (EMC Directive) and 73/23/EEC (Low Voltage Directive). To ensure that the instrument is used safely, follow all safety and operating instructions in this manual. If the instrument is not used as described in this manual, the safety features might be impaired.

WARNING

Non compliance with the warnings and/or the instructions for use may damage the instrument and/or its components or injure the operator.

Take extreme care under the following conditions when using the instrument:

- For your own safety and that of the instrument, you must follow the procedures described in this instruction manual and especially read all the notes proceeded by the symbol ⚠ carefully.
- Do not use this instrument in a location where there is explosive gas in the vicinity. The use of this instrument in a location where there is explosive gas could result in explosion.
- If there is any smoke, abnormal odor, or abnormal sound coming from this instrument, immediately switch off the power and disconnect the power cord. Continuous using of this instrument under these conditions could result in electrical shock or fire. After disconnecting the power cord, contact the service offices for repair. Repair by the user is dangerous and should be strictly avoided.

- Take care not to allow water to get into this instrument. The use of this instrument in a wet state could result in electrical shock or fire. If water or other foreign matter has penetrated this instrument, first switch the power off, remove the power cord and call for repair.

- Do not place this instrument on an unstable or slanting surface . The dropping or turning over of this instrument could result in electrical shock, injury or fire. If this instrument has been dropped or its cover has been damaged, switch the power off, remove the power cord and call for repair.
- Do not allow any foreign matter such as metal or inflammable substance to get into the instrument via the air holes. The penetration of any foreign matter from the ventilation holes could result in fire, electrical shock, or power failure.
- Use this instrument with the rated AC power source. Use of this instrument with a voltage other than specified could result in electrical shock, fire or power failure. The usable power voltage range is marked on the rear panel.
- Do not remove either the cover or panel.
- Take sufficient care when measuring high voltages.
- Do not modify this instrument.
- Avoid use of damaged cables .

2. SPECIFICATIONS

2.1 VERTICAL SYSTEM

Sensitivity	5mV/DIV. ~5V/DIV ±3%
Trimming Ratio	2.5:1
Rise Time	35ns
Bandwidth(-3dB)	DC:0~10MHz AC:10Hz~10MHz
Input Impedance	1MΩ ±3%,30 pF ±5pF
Max. Input Voltage	400V pk

2.2 TRIGGER SYSTEM

Trigger Sensitivity	Int 1 div., Ext 0.3V
Ext. Trigger Input Impedance	1MΩ 30pF
Ext. Trigger Max. Input Voltage	400Vpk
Trigger Sources	Int, Line, Ext
Trigger Mode	Norm, AUTO, TV

2.3 HORIZONTAL SYSTEM

Sweep Time	0.1S / DIV ~0.1μS / DIV ±3%
Trimming Ratio	2.5:1

2.4 X-Y MODE

Sensitivity	0.2V/DIV～0.5V/DIV
Bandwidth(-3dB)	DC: 0~1MHz AC: 10Hz~1MHz

2.5 CALIBRATION SIGNAL

Waveform	Symmetric Square Wave
Range	05.V ±2%
Frequency	1kHz ±2%

2.6 CRT

Display Area	8 × 10DIV 1DIV=6mm

Accelerating Voltage	1200V
Display Color	Green

2.7 POWER SOURCE

Voltage Range	110V±10% , 220V±10%
Frequency	50Hz ±2Hz
Power Consumption	25W

2.8 PHYSICAL FEATURES

Weight	3kg
Dimensions (H x W x D)	190 ×130 ×270mm

2.9 WORKING ENVIRONMENT

Working temperature	5°C ~ 40°C
Storage Environment	-30°C ~60°C, 10~80%RH
Working Altitude	≤2000m

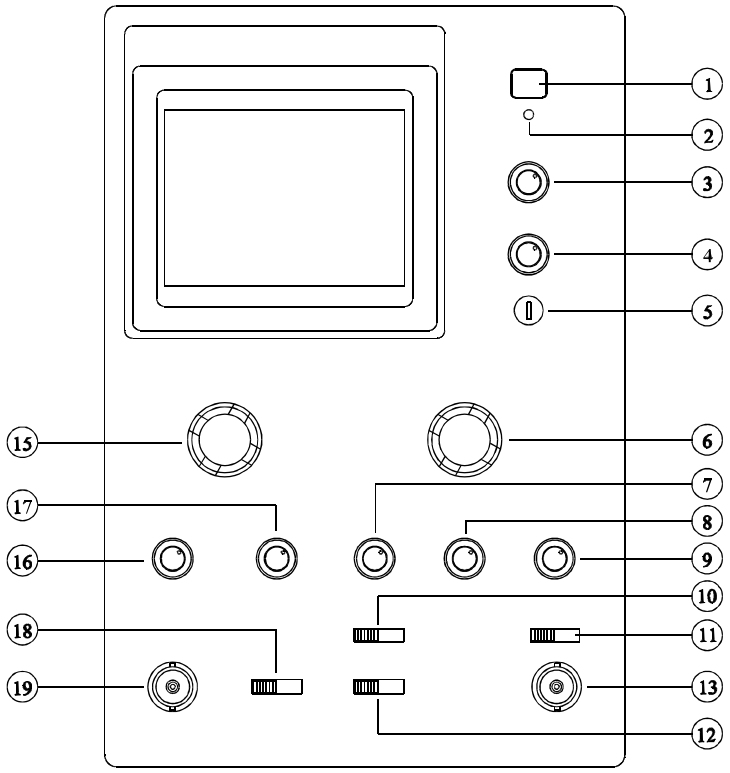
2.10 PRESSURE-PROOF TEST

Pressure-proof test	1500V 1min

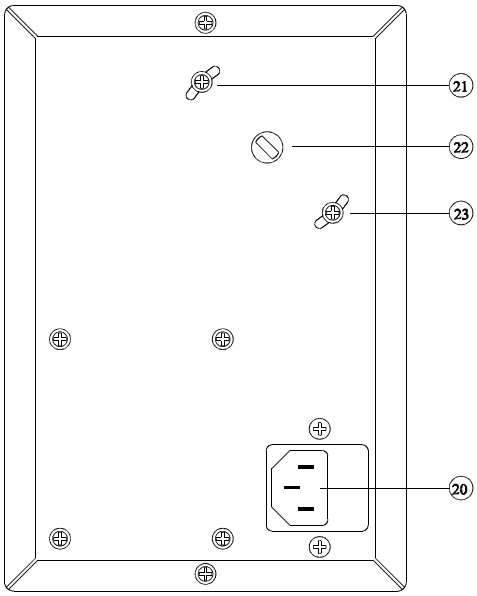
3. CONTROL AND INDICATORS

3.1 Control Panel Position

3.1.1 Front Panel Fig 3-1



3.1.2 Rear Panel Fig 3-2



3.2 FUNCTIONS OF CONTROL SWITCHES

NO.	SWITCHES	FUNCTIONS
1	POWER SWITCH	Power on/off
2	POWER LIGHT	Lights when power on
3	INTENSITY	Controls brightness of display
4	FOCUS	After obtaining appropriate brightness with INTENSITY, adjust FOCUS for clearest line
5	CALIBRATION	Provide symmetric square wave for 0.5V range, frequency=1KHz. Used for adjusting 10:1 Capacitor and adjusting the vertical & horizontal sensitivity.
6	TIME/DIV	Selects the sweep rate
7	Horizontal POSITION	Horizontal positioning control of trace on the screen
8	HORIZONTAL VAR	Provides continuously variable sweep rate, turn clock wise to the end is the calibrating position
9	LEVEL	Control signal trigger to sweep at certain level
10	+/- TV	+: Triggering occurs when trigger signal crosses trigger level in a positive-going direction. -: Triggering occurs when trigger signal crosses trigger level in a negative-going direction TV: used to show TV signals
11	AUTO/NORM EXT/X: X-Y	AUTO : a single trace shown on screen even no signal. Automatically reverts to triggered sweep operation when adequate triggered signal is present. Needs to adjust the Level. NORM: No trace on screen if no signal. Trace is only generated when adequate trigger signal is present EXT/X: X-Y switch
12	INT/EXT/LINE	Switch to select the Trigger Source INT/EXT/LINE
13	Ext. Trig Input Terminal	When switching [11] to EXT/X, it's X-Y input terminal; When switching [12] to EXT, it's Ext. Trig. Input terminal.
14	ATT	Continuously adjusting X-Y mode sensitivity, turn clockwise to obtain the highest sensitivity
15	VOLTS/DIV	Adjusting sensitivity of vertical system
16	Vertical POSITION	Control vertical position of trace on the screen
17	VERTICAL VAR	Continuously adjusting the sensitivity of vertical system, turn clockwise to the end is the calibration position
18	coupling options (AC⊥DC)	Selects input coupling options
19	INPUT	Vertical input terminal
20	POWER INPUT CONNECTOR AND FUSE	power input connector (refer to the rear panel for voltage) 110V±10% , 220 V ±10%;

3.3 OPERATING INSTRUCTIONS

3.3.1 VOLTAGE CHECKING

AT7016 oscilloscope is set for 110V±10% , 220V ±10% voltage. Before connecting the unit to the mains supply, make sure that the correct voltage is being used. Incorrect mains voltage may cause damage to the instrument.

3.3.2 BASIC OPERATION

(1) POSITION FOR CONTROL SWITCHES

CONTROL SWITCHES	POSITION
INTENSITY [3]	Center
FOCUS [4]	Center
POSITION [7] [16]	Center
VOLTS/DIV [15]	0.1V
VAR [8] [17]	Calibration position
AUTO/NORM [11]	Auto
TIME/DIV [6]	0.5mS
SLOPE +/- [10]	+
INT/EXT/LINE [12]	Int
AC⊥DC [18]	DC

(2) OPERATION

a. Power on [1],

b. Power lights at [2],

c. Allow a warm-up period of 5 minutes, then adjust the intensity[3],

d. Adjust focus [4] for clearest line. If unstable, adjust level [9] .

(3) Horizontal Level Adjustment :

a. Slightly turn screws [21][23] counter clockwise, but do not remove;

b. Insert a straight end screw driver to [22], and whilst observing the waveform, turn the screw driver in order to set the waveform parallel with the horizontal line ;

c. Tighten screws [21] [23].

(4) Connect the calibration signal [5] to Y input terminal[19] with 1:1 probe

(5) Adjust positions [7] [16] to obtain waveform like Fig 3-3.

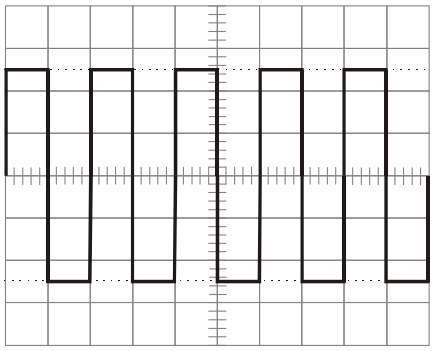


Fig 3-3

3.3.3 VERTICAL SYSTEM OPERATION

(1) VOLTS/DIV switch should be turned to the correct position following the input signal range. Adjust position [16] to show the whole waveform within the available area. Adjust with VAR [17] if necessarily, trimming ratio is 2.5:1.

(2) Input coupling options: “DC”is used for observing a signal with a direct current content such as logic or static signals, “DC” must be used with low frequency. “AC”is used for observing the AC component of signals. “⊥” (ground) is used to establish a trace at a zero volt reference.

(3) X-Y OPERATION: When [11] set at EXT/X, The oscilloscope is used for X-Y operation, at this moment Input [19] is Y-axis with the same sensitivity, Input [13] as X-axis, [14] can be adjusted continuously within 0.2V/DIV~0.5V/DIV.

3.3.4 TRIGGER SOURCE

In Fig 3-1, [12] provides 3 sources for selection, INT trigger, EXT trigger input from [13], LINE input from power source.

3.3.5 HORIZONTAL SYSTEM OPERATION

(1) Sweep setup : turn the sweep switch to the correct position according to the signal frequency and adjust POSITION [7] to show the whole waveform within the available area. Adjust with VAR [8] if necessarily, trimming ratio is 2.5:1.

(2) There are 3 kinds of Trigger sources: [11] “AUTO”auto sweep, when a triggering signal is applied, Level [9] will adjust to correct position. The screen showing a steady free run waveform requires a frequency higher than 20Hz; [11] “NORM”while waiting for sweep with no trace. When an input signal occurs the scope is triggered to sweep

(3) and show the waveform . [10] “TV” used to determine TV signals.

(4) SLOPE selection: Used to select whether the trigger signal crosses trigger level in a positive or a negative-going direction.

(5) Level setup : Use to adjust signal sweep on a level at a starting reference.

3.3.6 SIGNAL CONNECT

(1) Probe operation :

Use 10:1 to 1:1 switchable probes. When using 10:1 probe, input impedance is 10MΩ 16 pF. While if 1:1 is used for observing a signal, input impedance is 1MΩ 30 pF. At this stage, please consider the affect of the probe in certain circuits.

(2) Probe Adjustment

Before using , 10:1 probe must be adjusted correctly, see Point 4.1.2

4 Measurement

4.1 EXAMINATION AND ADJUSTMENT BEFORE MEASUREMENT

In order to ensure accuracy and prevent errors, the following observations should be made before taking a measurement.

4.1.1 TRACE ROTATION

The horizontal trace on the screen should be parallel with the horizontal line. Due to the earth's magnetic field and other factors which causes horizontal trace leaning you must examine the following before taking measurements:

(1) Adjust the front panel control to obtain a horizontal trace on the screen .

(2) Adjust the vertical position control to ensure the horizontal line in is centered.

(3) If the horizontal line/trace is not level, then please following point 3.3.2(3) to correct it .

4.1.2 PROBE COMPENSATION

Adjustment of the probe is required to compensate for the variations caused by difference in oscilloscope input characteristics:

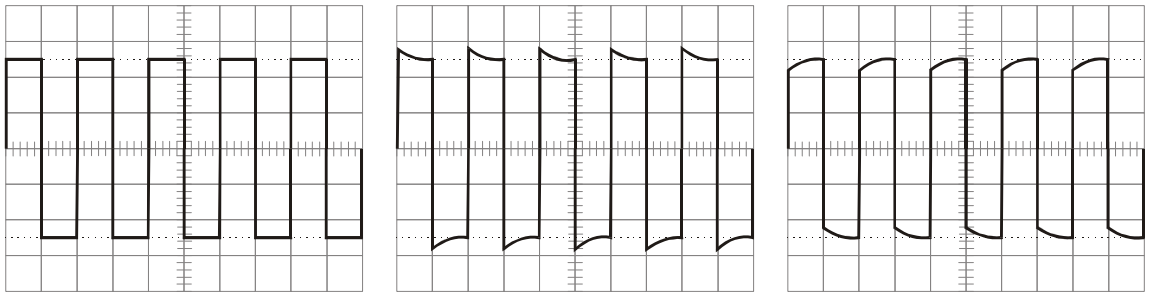
(1) Follow step 3.3.2, setup front panel controls, and obtain a sweep baseline.

(2) Set VOLTS/DIV to 10mV/DIV.

(3) Connect CH1 10:1 probe to input terminal, and connect to the "CAL" terminal.

(4) Follow Chapter 3 to operate relative controls, to obtain a waveform on the screen as shown in figure 4.1

(5) Observe the waveform compensation and adjust the LF compensation controls as shown in figure 4-2



Good Compensate | Over Compensate | Under Compensate

Fig 4-1

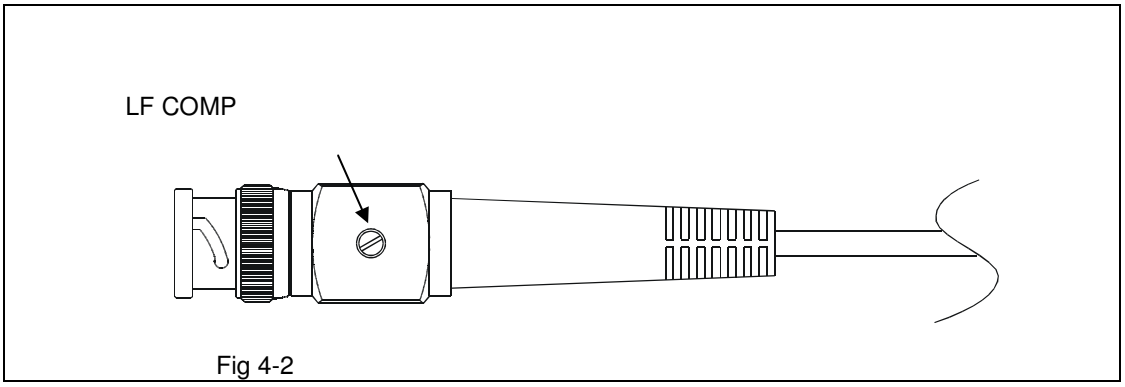


Fig 4-2

4.2 MEASUREMENT

4.2.1P-P Voltage Measurements

Step :

(1) Input signal to INPUT [19] terminal.

(2) Setup VOLTS/DIV and observe waveform, set waveform display on the screen within 5 divisions, and turn VAR clockwise to the calibration position.

(3) Adjust level to make waveform steady.

(4) Adjust sweep controls to show at least one cycle of the waveform is on the screen.

(5) Adjust vertical position to ensure the bottom of waveform lies on a horizontal axis on the screen. Fig 4-3A.

(6) Adjust horizontal position to ensure the top of waveform lies center of vertical axis. Fig 4-3B.

(7) Read the divisions between A-B on vertical direction.

(8) Calculate the signal Vp-p using the formula below :

Vp-p= DIV of vertical direction× Sensitivity

For example, In Fig 4-3, vertical divisions of A-B is 4.1 DIV, sensitivity of the 10:1 probe is 2V/DIV, then Vp-p=2×4.1=8.2(V)

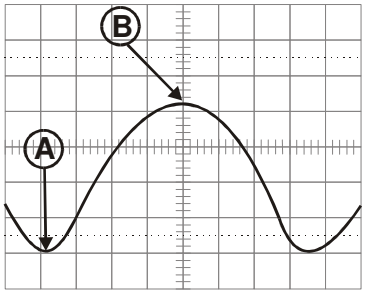


Fig 4-3

4.2.2 DC VOLTAGE MEASUREMENT

STEP:

(1) Setup front panel connector to obtain a sweep baseline on the screen.

(2) Setup input coupling options as "⊥".

(3) Setup POSITION, let sweep baseline to coincide with horizontal center, define it as the zero reference level.

(4) Input signal into terminal.

(5) Set input coupling to "DC", adjust VOLTS/DIV, so that the waveform is shown centrally on the screen, turn VAR to the calibration position.

(6) Read the divisions between the zero reference level to the waveform from the test input.

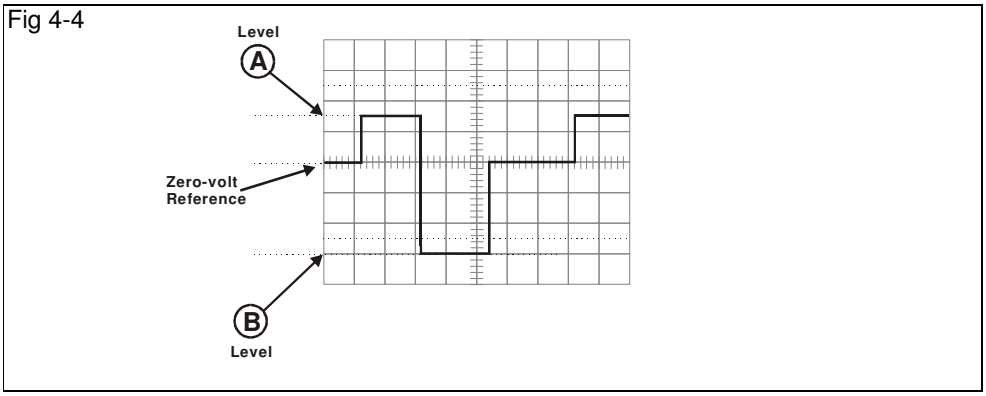
(7) Calculate the DC voltage:

V= divisions on vertical axis × sensitivity × direction(+/-)

Shown in Figure 4-4, zero reference level at the center, use 10:1probe, sensitivity is 2V/Div, 2 points as A & B, A is 1.5 Div. over the zero reference level, B is 3Div. below the zero reference level. DC voltage level of the 2 points are :

VA = 1.5 x 2 x (+) = 3 V VB = 3 x 2 x (-) = -6 V

Fig 4-4



4.3 TIME MEASUREMENTS

4.3.1 TIME SPACE MEASUREMENTS

This is a procedure for making time (period) measurements between two points on a waveform:

(1) Connect the signal to be measured to the input terminal [19].

(2) Adjust level to obtain steady waveform.

(3) Turn VAR clockwise to the calibration position, and set sweep controls to obtain a normal display of 1-2 signal cycles.

(4) Using the vertical and horizontal positions, set two points to be measured in the waveform on the same horizontal level.

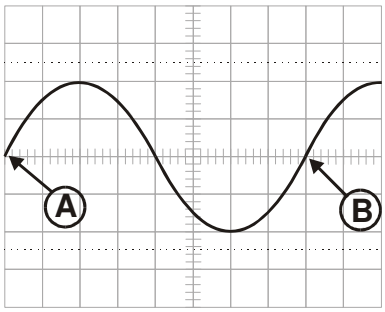
(5) Measure the distance between the two points , the measurement is calculated by the following equation:

$$\text{TIME (S)} = \frac{\text{Distance between 2 points (DIV)} \times \text{rate of sweep (t/Div)}}{}$$

Horizontal factor

Shown in figure 4-6, distance between A & B is 8 Div. sensitivity is 2 μS/Div, Horizontal factor x 1, then Time measurement is 16μS

Fig 4-6



4.3.2 CYCLE & FREQUENCY MEASUREMENTS

Shown in Fig 4-6, frequency measurements are made by measuring the time period of one cycle of waveform (T), and calculating the frequency that equals the reciprocal of the time period. For example, T=16μS, then frequency is:

$$F = 1/T = \frac{1}{16 \times 10^{-6}} = 62.5 \text{ KHz}$$

4.3.3 PULSE RISE TIME AND FALL TIME MEASUREMENTS

For rise time and fall time measurements, the 10% and 90% amplitude points are used as starting and ending reference points.

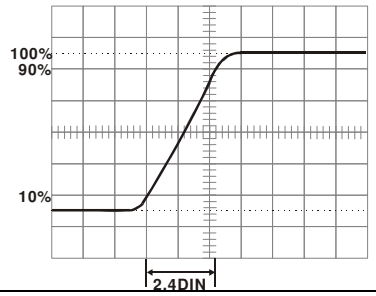
(1) Apply a signal to the input jack [19].
(2) Use the VOLTS/DIV and VAR controls to adjust the waveform peak to peak height to five divisions.
(3) Adjust vertical position so that the tops of the waveform coincide with 100% point, while the bottoms of the waveform coincide with 0% point.
(4) Adjust Sweep switch to obtain the positive-going direction or negative-going direction of the waveform on the screen.
(5) Use the horizontal POSITION control to adjust the 10% points to coincide with a vertical reference line.
(6) Measure the horizontal distance in divisions between the 10% and 90% points on the waveform (divisions).
(7) Pulse rise time and fall time measurement is calculated by the following equation:

$$\text{Rise Time} = \frac{\text{Horizontal distance (div)} \times \text{sensitivity (Time/div)}}{\text{Horizontal factor}}$$

For the example shown in Fig.4-7, the horizontal distance from 10% to 90% is 2.4 divisions, the sweep TIME/DIV setting is 1μS/DIV, factor x 1. The rise time is calculated as follows:

$$\text{Rise Time} = \frac{1\mu S/DIV \times 2.4DIV}{1} = 2.4\mu S$$

Fig. 4-7



4.4 TV Signals measurement

Steps :

(1) Connect TV signals to INPUT jack [19]

(2) Set Trigger method to “TV” [10], Sweep switch turn to 2mS/Div.

(3) Observe the screen, it should be negative synchronize pulse wave.

(4) Adjust VOLTS/DIV and VAR to obtain proper range.

4.5 X– Y mode applications

There are some cases which X axis requires control from external signals, e.g. external connection of sweep signals, signals of Lissajous patterns or other equipment’s display setup. X-Y mode operation is turn [11] to EXT/X, input signals through [13], sensitivity to be adjusted directly with [14], then input Y signal through [19].

5 . ACCESSORIES

1 Probe 1 pc.

2 Cord 1 pc.

3 User’s manual

⚠ WARNING

DO NOT OPEN THE CASE, HIGH VOLTAGE EXISTED.

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